

# SCIENCE

# And Technology Program



Donald Frevert and Terrance Fulp

Continuing since FY 1995

Accurate and timely information is crucial to the planning, scheduling, and operation of water and power resources. These data include the distribution of precipitation and inflow into the watershed, stream flows, reservoir levels, and water and power demands. Historical, predicted, and synthetically generated data are needed to evaluate the relative benefits and risks associated with alternative operating strategies. These data must be readily available and the modeling outputs easily accessible to qualitatively and quantitatively assess the relative benefits and risks of decisions. Throughout Reclamation, these data have not been readily accessible. Older models have proven to be very inflexible and difficult to use to evaluate new policy scenarios to meet new and rapidly changing objectives.

The project objectives are to research, develop, test, and implement decision support systems which will integrate meteorological, hydrological, reservoir, river, and power systems data with modeling and analysis modules. These systems are developed on a need driven basis, focusing on river basins in the western United States where improved models and data management systems are required, critical water resources problems are being faced, and there is substantial potential for interagency participation.

Developments and improvements of technology during FY 1999 include:

Additional RiverWare capabilities for accounting were developed by Reclamation's primary contractor - the CADSWES group at the University of Colorado. These capabilities allow for multiple water users within a given priority to divide inflows, losses, and gains to reservoirs among specific accounts; to improve accounting diagnostics; and to generally improve performance in terms of run time. Additional capabilities were added to model water exchanges and direct their implementation by use of operating policies.

Improvements in the area of rules performance have also been completed by CADSWES. A new language has been implemented which allows easier and faster development of rules, as well as improved performance time. Enhancements have been made to physical process models for reach routing and groundwater interaction. Uncertainty calculations have been added to the Muskingum-Cunge routing method for use on low flow studies on the Pecos River basin.

Training classes in RiverWare were offered in April 1999 (the basic introductory class) and in August 1999 (the advanced rule based simulation class). A meeting of the RiverWare user's group was held on June 30 and July 1, with very positive results.

Ports to Oracle for the Hydrologic Data Base were completed on the Upper and Lower Colorado Region and an Oracle data base was put in place for the Yakima basin.

Conjunctive use functionality was added to RiverWare for use by the Yakima Area Office. New methodology was developed to simulate the irrigation process on the Yakima River Basin. Overall, the basic simulation of the Yakima River basin using RiverWare, the Hydrologic Data Base, and the Modular Modeling System progressed during FY 1999 and is expected to be completed next year. A basic RiverWare model for the Umatilla Basin has also been developed.

# SCIENCE

# And Technology Program



Improvements to the evapotranspiration (ET) toolbox have been made using the Rio Grande basin as a study area. Internet access is now available to high resolution rainfall and daily crop water-use estimates for improving the efficiency of water management and irrigation scheduling. The ET toolbox integrates rainfall estimates with weather data from automated stations, GIS mapping, remote sensing vegetation imagery, communication technology, and modified Penman estimates of evapotranspiration to provide estimates of daily water requirements for managers. In a June ET field study, aircraft photos were taken of the area.

Discussions on the possible use of RiverWare were held with representatives of Australian and South African water resources agencies. The RiverWare co-principal investigator, Dr. Terry Fulp, and Dr. George Leavesley, his USGS counterpart, participated in a workshop with the Japanese Public Works Research Institute to explore possible applications of RiverWare and the Hydrologic Data Base to water resources problems in Japan and to enhance cooperation between Japan and the United States related to sharing water resources technology.

Technical experts from Reclamation and other cooperators presented the results of this research at the Department of the Interior Conference on the Environment, the annual meeting of the Association of State Flood Plain Managers, the Water Power 99 conference, and the American Society of Civil Engineers International Conference on Water Resources Engineering.

The independent Technical Review Panel met in January 1999 to review progress on the program. The panel provided a detailed technical review which was very positive in terms of progress made and recommendations implemented. The report was distributed to members of the WaRSMP team and other interested parties.

An effort was begun with Dr. Jose D. Salas of Colorado State University for developments of interfaces between RiverWare and HDB, the recently developed SAMS (Stochastic Analysis, Modeling and Simulation) package. This effort is expected to be completed by the end of 2000.

Partners participating through major financial investment in the project include USGS, the Tennessee Valley Authority and the University of Colorado's Center for Advanced Decision Support for Water and Environmental Systems. Major financial support was also provided by Reclamation's Upper and Lower Colorado Regional Offices and the Albuquerque Area Office. In addition, a number of other partners participated through in kind services, including Colorado State University, Utah State University, and the U.S. Army Corps of Engineers. Louisiana State University provided technical services from Dr. Vijay Singh, through the terms of an Interagency Personnel Agreement.

Burroughs, Craig, and Karl Martin. 1999. Water Operations Model for the Pecos River. Proceedings of the American Society of Civil Engineers International Conference on Water Resources Engineering.

Fulp, Terrance P., and Donald K. Frevert. 1999. The Watershed and River Systems Management Program: An Overview of Applications in the Bureau of Reclamation. Poster Presentation at the Department of the Interior Conference on the Environment.

Frevert, Donald, Terrance Fulp, and Shannon Cunniff. 1999. Opportunities for Use of RiverWare to Assist Floodplain Managers in the West. Proceedings of the Annual Meeting of the Association of State Floodplain

# SCIENCE

# *And Technology Program*



Managers.

Carron, John, et al. Uncertainty Modeling in RiverWare. Abstract accepted for presentation at the American Society of Civil Engineers Watershed Management 2000 Conference, June 2000.

Frevert, Donald et al. The Watershed and River Systems Management Program - An Overview of Capabilities. Abstract accepted for presentation at the American Society of Civil Engineers Watershed Management 2000 Conference, June 2000.

An interagency workshop to discuss recently completed studies of evapotranspiration and water consumption in the Rio Grande Basin was hosted in Santa Fe, New Mexico, on February 18, 1999. Discussions were highly productive. A video cassette describing the evapotranspiration research on the Rio Grande was produced and is being used to increase public awareness and understanding of this work.